

REMARKS

Claims 59-78 are pending. Claims 59, 60, 61, and 62 are hereby amended to better define the invention and Claims 66 and 67 are hereby canceled. New Claims 69-78, which are a dependent claim (70) and otherwise (71-78) generally commensurate in scope with Claims 59-68, are submitted for consideration. Reconsideration and allowance are respectfully requested in light of the following remarks.

Objection to Drawings

Claims 66 and 67 referring to a second iodine injection strut are hereby cancelled. It is respectfully submitted that the drawing objection is thereby rendered moot. The cancellation of these claims does not surrender subject matter relating to multiple injection struts because of the transitional phrase "comprising" in the claims that recite "at least one injection strut."

Objection to Specification

The specification is hereby amended to re-insert the objected-to language. While Applicant does not agree that the earlier deletion of this language constitutes new matter, in an effort to facilitate the prosecution of this Application, the language is hereby re-introduced into the Specification, rendering the objection moot.

Rejection under 35 U.S.C. § 112

Claims 59-68 were rejected under 35 U.S.C. § 112, first and second paragraphs. The following arguments are directed toward now pending Claims 59-68, as appropriate.

Claim 59, as amended, recites the term “laser” in the preamble in the same fashion as original and elected Claim 1. It and the dependent claims therefore are similar in scope to now-canceled Claim 1 and its dependents. Accordingly, Applicant submits that the rejection is overcome.

Further, the term “MLN” or “minimum length nozzle” has been removed from the pending claims in favor of the recitation of a “sharp corner” in the throat of the nozzle, a structural characteristic of all MLNs, as noted at page 5 of the Specification. Also, the “curved sonic line” is a flow characteristic of a MLN that results from its configuration as an MLN, as noted at page 5 and elsewhere in the Specification.

With respect to “the transonic boundary” in Claim 59, the definite article has been replaced with an indefinite article to avoid the antecedent basis problem.

With respect to “the downstream end” in Claim 60, the definite article has been replaced with an indefinite article to avoid the antecedent basis problem.

The dependency and antecedent basis problems in Claim 61 have been corrected.

Claim 62 is hereby amended to depend from Claim 59 as originally intended.

In view of these amendments, the rejections under 35 U.S.C. § 112 are submitted to be overcome.

Rejections under 35 U.S.C. § 103

The pending claims stand rejected under 35 U.S.C. § 103 as obvious in view of Dickerson. According to the final Office Action:

Dickerson discloses an iodine injection system comprising:

a gas generator 15;

a cavity 26;

a symmetric two dimensional minimum length nozzle 10 having:

a throat 18;

an exit plane (such as plane defined by wires 24);

at least one iodine injection strut 20 that is located downstream of the throat 18.

Applicant respectfully submits that Dickerson is misconstrued and that, properly construed, the invention is not rendered obvious. Accordingly, the rejection is traversed.

The following section of the specification of Dickerson represents its pertinent disclosure:

DETAILED DESCRIPTION OF THE
PREFERRED EMBODIMENT

Referring now to the drawings and the characters of reference thereon, the sole figure illustrates a preferred embodiment of the present invention, designated generally as 10. The COIL gain generator system 10 includes a reactor, designated generally as 12. The reactor 12 includes a chlorine manifold 14 and a BHP manifold 16 for introducing gaseous chlorine 15 and liquid BHP 17, respectively, to a reactor chamber 18. The chlorine manifold 14 is typically a perforated plate (not shown) for providing uniform disbursement of chlorine. The gaseous chlorine contains little or no diluent which helps avoid liquid BHP carryover out of the reactor 12. The BHP manifold 16 typically includes an orifice plate (not shown) which disperses the BHP into jets or droplets, thus providing a high liquid surface area for reaction with chlorine to produce singlet delta oxygen. The reactor chamber 18 typically has a larger cross-sectional area than downstream components so that the gas velocity is low enough to avoid carryover of liquid BHP into the downstream components. The BHP liquid surface area per unit volume in the reactor chamber 18 is kept as high as practical to promote fast reaction of the chlorine with the BHP and short residence time of singlet delta oxygen product.

The singlet delta oxygen product from the reactor chamber 18 is passed through an array of supersonic nozzles 20. (It is not actually passed in the nozzles 20, but is instead passed through spaces between exterior surfaces of the nozzles 20.) A high pressure mixture 21 of gaseous diluent and iodine is passed through the nozzles 20. The diluent has a high molecular weight, i.e., greater than 4. It preferably comprises nitrogen; however, other suitable diluents may be used, such as argon, neon, fluorocarbons, or mixtures of the above, with lighter weight species, such as helium or hydrogen to form a high average molecular weight mixture. As the diluent flows through the nozzles 20 it accelerates to a Mach number >3.5 , typically around 5.0. The iodine can be either premixed with the diluent, as shown in FIG. 1, or introduced through separate orifices slightly upstream or slightly downstream of the nozzles 20.

In the mixing zone 22 downstream of the nozzles 20 the diluent, iodine and singlet delta oxygen are intimately mixed. This mixing is facilitated by nozzles 20 being closely spaced, with the singlet delta oxygen flowing therebetween. They are generally spaced about 0.1 to 1-inch apart. Simultaneous with the mixing process, the iodine is disassociated into iodine atoms by reaction with the singlet delta oxygen. As this process nears completion, the iodine atoms provide the laser gain needed to produce lasing. An aerodynamic disturbance element, such as an array of fine wires 24, may be used to initiate the reaction of the singlet delta oxygen and the iodine.

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The high Mach number (>3) of the mixture maintains the static temperature (i.e., typically <175 Kelvin) to the low values needed for efficient lasing.

The mixture then flows into a laser cavity 26 where laser power is extracted from the mixture. Downstream of the laser cavity 26 the mixture flows into a supersonic/subsonic diffuser 28 which recovers pressure by converting the high momentum gas to a low momentum gas.

The amount of pressure recovered in the diffuser 28 is increased by the high average molecular weight (i.e., >10) and the high Mach number (i.e., >3) of the mixture.

The high recovered pressure allowed use of a relatively small exhaust pumping system. For a non-noble diluent, the pumping system could be a chemical pump.

As can be seen from the foregoing text, numeral 10 refers to a gain generator system and not a nozzle, as claimed. Numeral 18 refers only to a reactor chamber for generation of singlet oxygen, not a throat. And, inasmuch as there is no nozzle 10, there is no exit plane.

The only "nozzle" referred to in Dickerson is the array of supersonic nozzles 20. These nozzles are not shown to have a sharp corner in their respective throats, nor are they disclosed to be MLN nozzles, with or without curved sonic lines. Indeed, the terms "MLN," "throat," "sharp corner," and "curved sonic line" do not appear anywhere in the disclosure of Dickerson, nor are they implicit as the final Office Action seems to contend. Further, Dickerson does not disclose a throat connecting convergent and downstream divergent sections of the nozzle as recited in new Claim 71.

The nozzle of the claimed invention accelerates the gas flowing through it to supersonic levels at its exit plane. By using a nozzle having a sharp corner at the throat and a curved sonic line characteristic (e.g. a minimum length nozzle or MLN), the length or distance over which the acceleration of the gas to lasing levels occurs is minimized. Iodine is injected into the stream via the struts as disclosed and claimed.

As previously stated, the only nozzle for accelerating gas in Dickerson is the array of nozzles 20, through which diluent(s) and iodine are accelerated to supersonic velocity as described here:

The singlet delta oxygen product from the reactor chamber 18 is passed through an array of supersonic nozzles 20. (It is not actually passed in the nozzles 20, but is instead passed through spaces between exterior surfaces of the nozzles 20.) A high pressure mixture 21 of gaseous diluent and iodine is passed through the nozzles 20. The diluent has a high molecular weight, i.e., greater than 4. It preferably comprises nitrogen; however, other suitable diluents may be used, such as argon, neon, fluorocarbons, or mixtures of the above, with lighter weight species, such as helium or hydrogen to form a high average molecular weight mixture. As the diluent flows through the nozzles 20 it accelerates to a Mach number >3.5 , typically around 5.0. The iodine can be either premixed with the diluent, as shown in FIG. 1, or introduced through separate orifices slightly upstream or slightly downstream of the nozzles 20.

The supersonic mixture of iodine and diluent mixes with and accelerates the singlet oxygen by transfer of momentum to supersonic levels, rather than by action of any nozzle on the flowing gas other than the iodine and diluent mixture.

Thus, in addition to failing to disclose, teach or suggest the claimed structural elements of the claimed invention, Dickerson operates in a markedly different fashion. Therefore, it is respectfully submitted that it cannot anticipate nor render obvious the claimed invention.

Conclusion

Applicant submits the fee required for the accompanying Request for Continued Examination. Applicant does not believe that any other fees are due; however, in the event that any fees are due, the Commissioner is hereby authorized to charge any required fees due (other than issue fees), and to credit any overpayment made, in connection with the filing of this paper, to Deposit Account 50-2180 of Storm LLP.

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Should the Examiner require any further clarification to place this Application in condition for allowance, the Examiner is invited to telephone the undersigned at the number listed below.

Respectfully submitted,

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